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ADP010614

TITLE: Transferring VR Technology Between Military and Non-Military Applications

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TITLE: The Capability of Virtual Reality to Meet Military Requirements [la Capacite de la rea1ite virtuelle a repondre aux besoins militaires]

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ADP010609 thru ADP010633

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TRANSFERRING VR TECHNOLOGY BETWEEN MILITARY AND NON-MILITARY APPLICATIONS

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ABSTRACT

Virtual Reality (VR) technology for commercial applications has been oversold to the public during the past 2 to 3 years. There have, however, been relatively few success stories outside of entertainment, but that does not mean VR cannot meet the requirements of non-military applications. It is important that we take a broader view of VR than helmet-mounted displays and wearable technology, one that includes interfaces able to display high fidelity 3D environments and models. In this paper I discuss the methodologies for accomplishing technology transfer. These include cooperative agreements, corporate funded R&D, and government funded initiatives. The requirements of commercial application domains, including industrial operations, government (non defense) operations, healthcare and entertainment are discussed and related to military training systems. Last I will propose ways that these two communities can work together on joint research and development, transferring technology bi-directionally, and the use of forums to enhance dialog and discussion. This paper is intended to stimulate a discussion of issues (such as intellectual property) which are appropriate agenda items for future joint discussions and workshops supported by both defense and non-defense VR developers.

INTRODUCTION

Virtual Reality (VR) captured the public's imagination and has been the darling of the technical communities that develop cutting edge computer interfaces and graphics computing capabilities. But like so many other promising technologies, it has been slow to mature sufficiently to be affordable, reliable, and to possess sufficient capability to meet the incited expectations. So now we hear plaints that VR is not really needed, that is too expensive, too slow, and too hard for its users to make a conceptual leap from what they see to the features of the real world a particular VR-based synthetic environments allegedly represented.

A different perspective is needed in order for VR to realize its potential. First, I propose we begin from an application perspective rather than, the more frequently taken, presentation viewpoint. Rather than being enamored with the "gee whiz" nature of VR, we need to see it as a feature of simulation technology, specifically user interface methodology. Furthermore, we should think of simulations as tools that aid their users in making decisions. These decisions can be for the purpose of learning, managing, or even of being entertained. But in any case the users have a certain goal in mind when they use a computer-based simulation. The user's interface to the simulation should be chosen or designed with a notion of that goal in mind.

Simulations are intended to be a model of some phenomena which exists in the world. Those phenomena could be some part or aspect of the world that is directly observable as well as one that is subatomic or even imaginary. In either case the use of VR as an interface mechanism exists solely to aid users in mapping the representation in computer simulation to their own conceptual understanding. With these perspectives in mind, let us consider how the needs for adequate VR technology to meet the needs of both military training and the commercial world complement one another and what we can do to collaboratively develop those capabilities.

METHODOLOGIES FOR ACCOMPLISHING TECHNOLOGY TRANSFER

Technology that has potential for dual use in both military and commercial settings has been long sought after. In the United States the federal government has tried mandating these efforts, encouraging government agencies to seek out opportunities to transfer their good ideas to commercial practice and even directly providing funding to accomplish technology transfer. While the notion has obvious appeal it has most often been unsuccessful because of the difficulty in

Paper presented at the RTO HFM Workshop on "The Capability of Virtual Reality to Meet Military Requirements", held in Orlando, USA, 5-9 December 1997, and published in RTO MP-54.

stimulating a market for what are most often technologies for producing or defeating violence. Computer technology, especially better approaches to interfacing users to software, is a technology that can serve multiple purposes right from its development. We will examine some approaches to accomplishing dual use of VR technology.

Cooperative agreements between government development activities, such as laboratories or procurement commands, and non-defense activities, both commercial companies and university-sponsored research centers, should be considered as a way to reduce development costs. Cooperative agreements can be used to either leverage available funding or reduce costs of development by using the resources which a university research center offers. The difficulty with these agreements is insuring that property right issues are clearly addressed in the agreement itself so that future disputes over ownership and the rights to apply the results are clearly defined. I recommend that no one be permitted exclusive ownership of any cooperatively developed technology or product, rather those should be shared with full access to either party.
It might appear that corporate funded research and development will not achieve the goal of providing needed technology to the military. However, often contractors and companies, especially defense contractors, expend their limited R&D funds developing capabilities that do not meet the requirements of the military. Sometimes these capabilities have commercial application, but dual use technologies able to meet both defense requirements and find a niche in the marketplace are the ideal. The way for government activities to best leverage corporate R&D is to willingly define their requirements to industry. Dialog between government and commercial industry are important, there should be open exchange of information at the technology level. This does not mean that the possibility that something new, innovative, and revolutionary being developed by industry should be overlooked. There will always be innovations that will serve new purposes that are not yet defined. Government agents need to be alert to these, especially those that will improve defense training or combat capabilities enhancing combat effectiveness.

Last, there will always be a need for government funded research initiatives. Some government funding is needed to cultivate new technologies that will improve combat effectiveness because warriors can train better or operate more efficiently. Government scientists should not rely on their own laboratories to innovate all new technologies for their militaries. Defining what development needs to take place and sponsoring funding for it outside of government laboratories is still critical. A suitable strategy for meeting the technology needs of future military forces requires R&D organizations to adopt a strategy that includes all three types of approaches to leveraging capabilities outside of their own organizations. Cooperative efforts, dialog with industry on needs to guide corporate R&D investments, and government funded research should be components of such a strategy.

REQUIREMENTS FOR COMMERCIAL APPLICATIONS DOMAINS

I will discuss some of the basic requirements for VR interfaces to simulations in key non-military application areas. Keep in mind the perspective proposed in the introduction: that these simulations are tools that support decision-making and may benefit from the ability of VR technology to provide an immersive interface to that simulation. The areas for discussion are defined in four broad areas: industrial operations, government operations, healthcare, and entertainment.

Simulations to support industrial operations are not necessarily new, operations researchers, management scientists, and industrial engineers have used simulations to support their analyses for years. What is new is the opportunity to use simulations at a higher conceptual level to build and run on desktop platforms, enterprise level models. These simulations capture the emergent properties top-down for a given business enterprise. Today we can model entire factories, distribution systems, processing plants and etc., delivering those simulations to the manager's computer desktop for him or her to use for strategic planning and day to day operations. Given that these types of simulations will serve not just analysts but managers as well, we must consider when immersive technology adds to the ability of the non-technical user to relate what the computer presents to his or her understanding of the real world features being represented. VR technology will be of use if it is affordable and easy to use. Strap-on wearable equipment will probably not find favor with management level decision-makers. However, high resolution three dimensional presentations designed to aid understanding will find an eager market.

Local and state governments must meet an ever-increasing number of informed constituent groups. They are being held accountable for social programs, economic development and efficiency of public services. Simulations which, like those discussed above for industry managers, capture the overall characteristics of a government operation and which can be used to better plan for the future and manage day to day operations will be soon available to government officials. These simulations need an interface that not only helps decision makers, such as city managers and their staffs, do their jobs

better but are also suitable for explaining decisions to elected officials and the electorate. Planned investment in new infrastructures, such as schools, emergency services, or transportation, will be simulated to make the best choices and then demonstrated to the public. Three-dimensional high-resolution display technology as part of a simulation system based on GIS or other existing terrain databases will be in demand. These are the same features military trainers and operational planners want in their training or planning systems.

Healthcare needs simulations to help them more efficiently manage their operations and train medical personnel. Patient simulators are already under development. These full-size replicas of humans can train healthcare professionals in proper procedures for handling emergency medical situations. A VR system that permits personnel to practice similar procedures would also be widely accepted. This is a case where both the ability to display three dimensional images, but from a more limited image database than needed in the above domains, is important, and where the immersive capabilities of the system are important. The requirements for VR technology able to support similar medical training in both the commercial and military communities exists, but can serve other military training needs as well (e.g., dismounted warfare training). Also, managers of facilities and programs in healthcare will, in the near future, be seeking simulations to help them better manage their enterprises. Their requirements for VR technology will be similar to those of industrial and urban operations discussed above.

Entertainment has been viewed as a natural ally and collaborator in developing VR technology. The military training and entertainment communities have common interface capabilities per se, HMDs, interaction devices, and display screens. Collaborative efforts are therefore worth pursuing. One must understand though that entertainment requirements and the liberties taken in how they use the technology may impact the ability of what is developed to meet military requirements. Entertainment does not have to concern itself with fidelity to real world constraints (i.e., the laws of physics). It is more concerned with establishing a story telling context. Also entertainment can often afford to sacrifice scene fidelity for cost. Military training systems have to insure that whatever is delivered into the hands of warriors matches fidelity with tasks being trained. Sometimes the goals of entertainment and training are in opposition. I recommend that our best approach with entertainment is to let those organizations develop technology based on their profit incentives and determine, after it is completed, what capabilities it has to meet military requirements with or without modifications.

COLLABORATION BETWEEN DEFENSE AND COMMERCIAL APPLICATIONS

Given that there are common needs and opportunities to collaboratively develop technology between defense and some commercial areas I would like to discuss some ways to implement that collaboration.

Joint research and development involving government agencies and either academia or industry is probably the most difficult approach. It requires a clearly defined objective and plan. The agencies involved must agree early on what the project expects to accomplish. Each party involved should insure that those objectives will help them to meet their own organization's requirements when completed. This is key to embarking on a joint project, but more important to the overall success is a commonly agreed upon project plan with a specific schedule that includes milestones, planned reviews, and an agreed upon commitment of resources. R&D often has poorly defined end points and in many cases that is not necessarily bad, but in the case of joint efforts, better definition is required to insure the parties involved do not feel that the project failed them.

Frequently overlooked is the opportunity to transfer technology bi-directionally. Not only can government developed technology frequently be applied to meet commercial needs, but existing commercial technology is often able to meet military requirements with little or no modification. A model for accomplishing this is to establish partnerships between government agencies and other research centers that allow the research center access to government technology. This is usually accomplished through some sort of cooperative research agreement or memorandum of understanding. The partnership also should include a complementary contract vehicle that allows the government activity to procure honest broker services from the research center to help them evaluate commercial technology.

Information exchange between commercial and military sectors is probably the easiest way for these two communities to exchange useful ideas. Journals and conference proceedings that describe research are valuable. However, workshops and the actual conferences themselves are perhaps best. These types of forums allow researchers to dialog about what has been accomplished and understand best how to potentially apply it to meet their needs. They also allow ideas and requirements for future research to be exchanged.

SUMMARY

VR may not have met the public's expectations based on its hype as presented in the media but we, as a community, should not become discouraged. We must continue to work not just to improve display technology, a lot of which is being done by the OEM community to meet other needs (such as entertainment), but to work collaboratively with two purposes in mind. First we need to understand where common technical requirements exist that can help each meet our own requirements. Second we must be able to recognize and develop new capabilities in joint projects or by information exchange early in the R&D lifecycle. Only through joint and cooperative research and information sharing will VR technology move ahead and eventually meets the promises everyone holds for it. As a community we need to commit to working more closely together and enter into a dialog that addresses the issues involved in such collaboration.